

Fossil-Fuel CO₂ Emission Estimates and Projections from the U.S. Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC)

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Carbon Dioxide Information
Analysis Center
Oak Ridge National Laboratory**

**ESIP Federation Summer Meeting 2010
University of Tennessee
Knoxville, Tennessee
July 22, 2010**

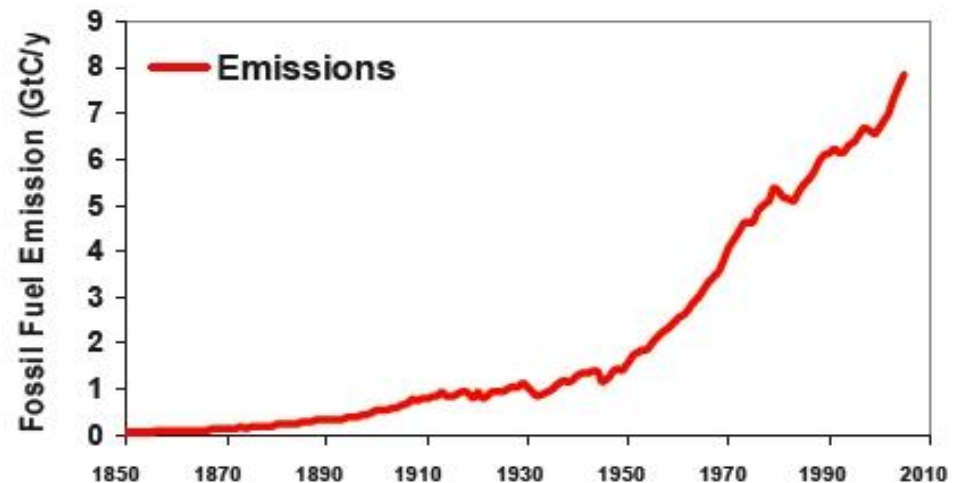


Anthropogenic C Emissions: Fossil Fuel



2006 Fossil Fuel: **8.4 Pg C**

[2006-Total Anthrop. Emissions: $8.4 + 1.5 = 9.9$ Pg]

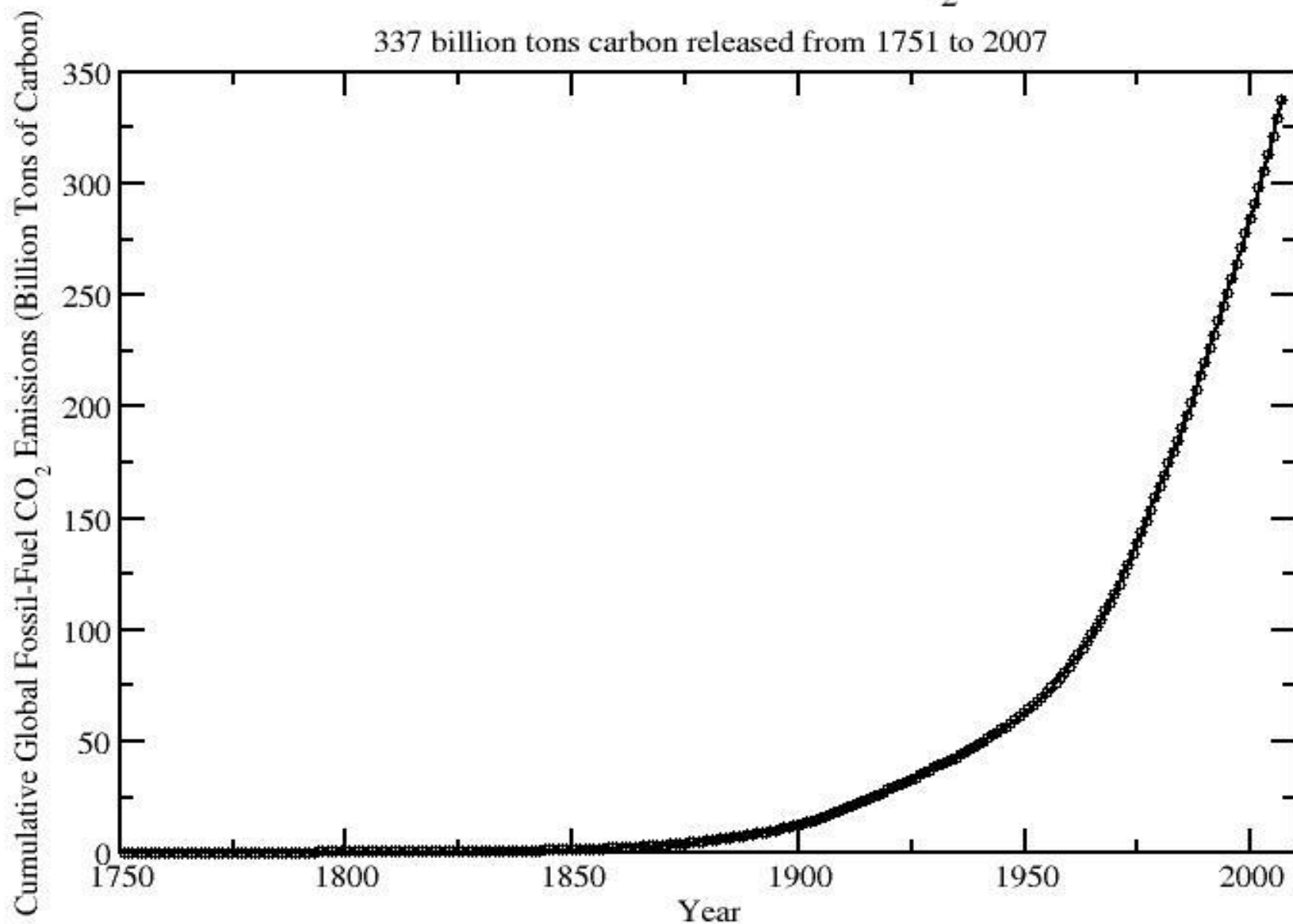


1990 - 1999: **1.3% y^{-1}**

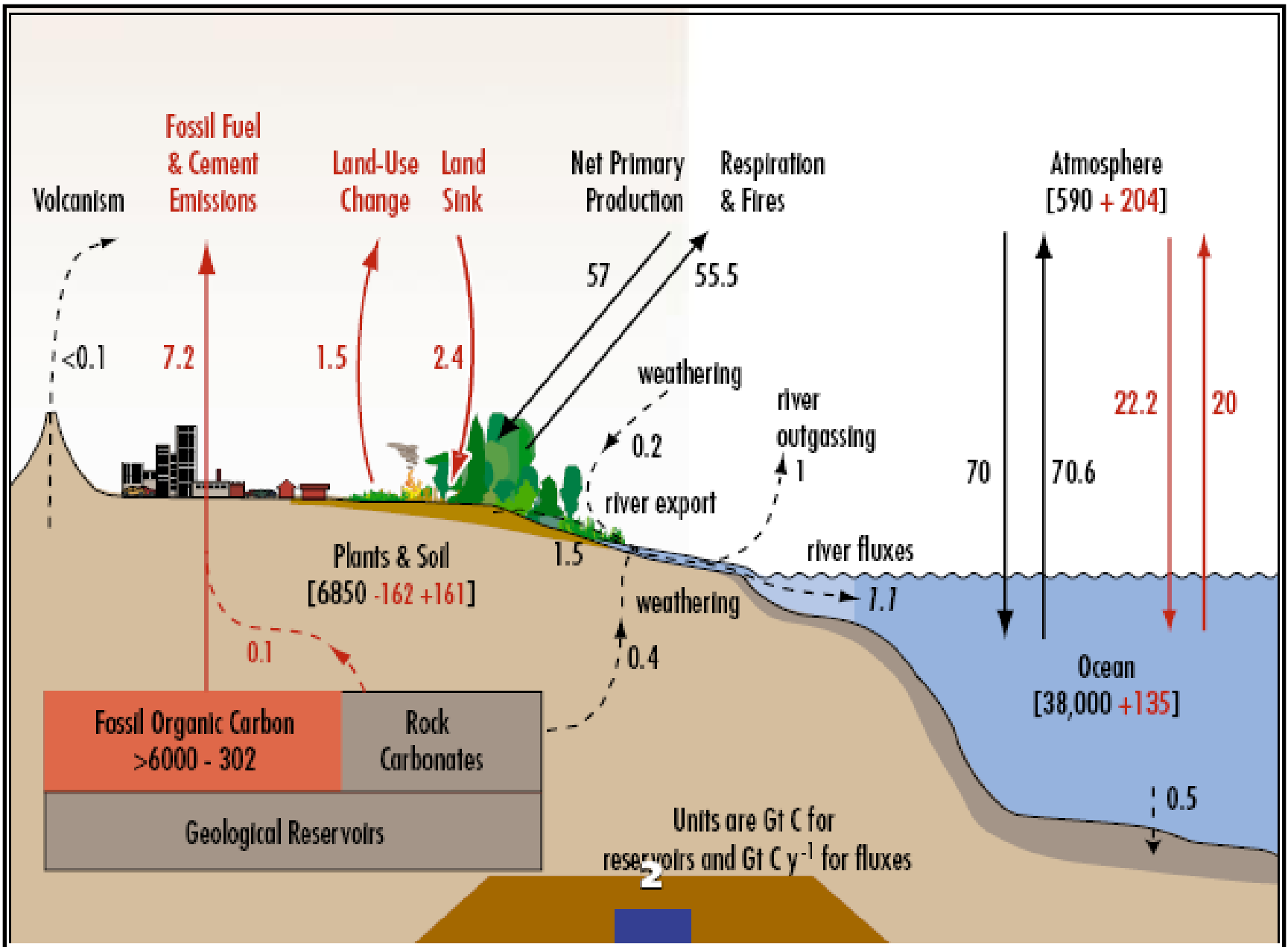
2000 - 2006: **3.3% y^{-1}**

Cumulative Global Fossil-Fuel CO₂ Emissions

337 billion tons carbon released from 1751 to 2007



Carbon Cycle Budget



Data Sources

UN Energy
Statistics

USGS Cement
Production

UN Population
Estimates

Processing

Data Integration
QA/QC Checks
Net Apparent Consumption
CO₂ Emission Calculations

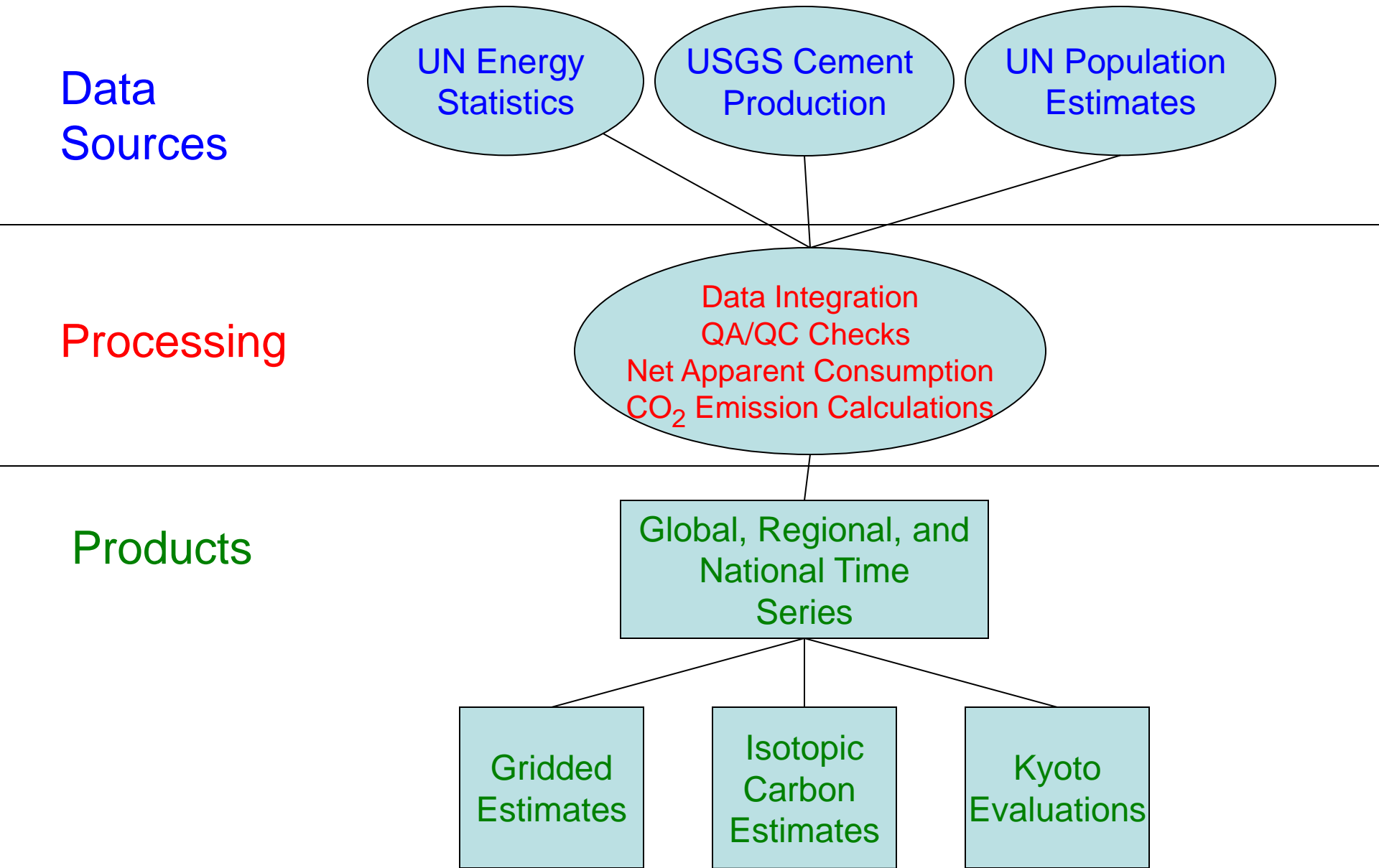
Products

Global, Regional, and
National Time
Series

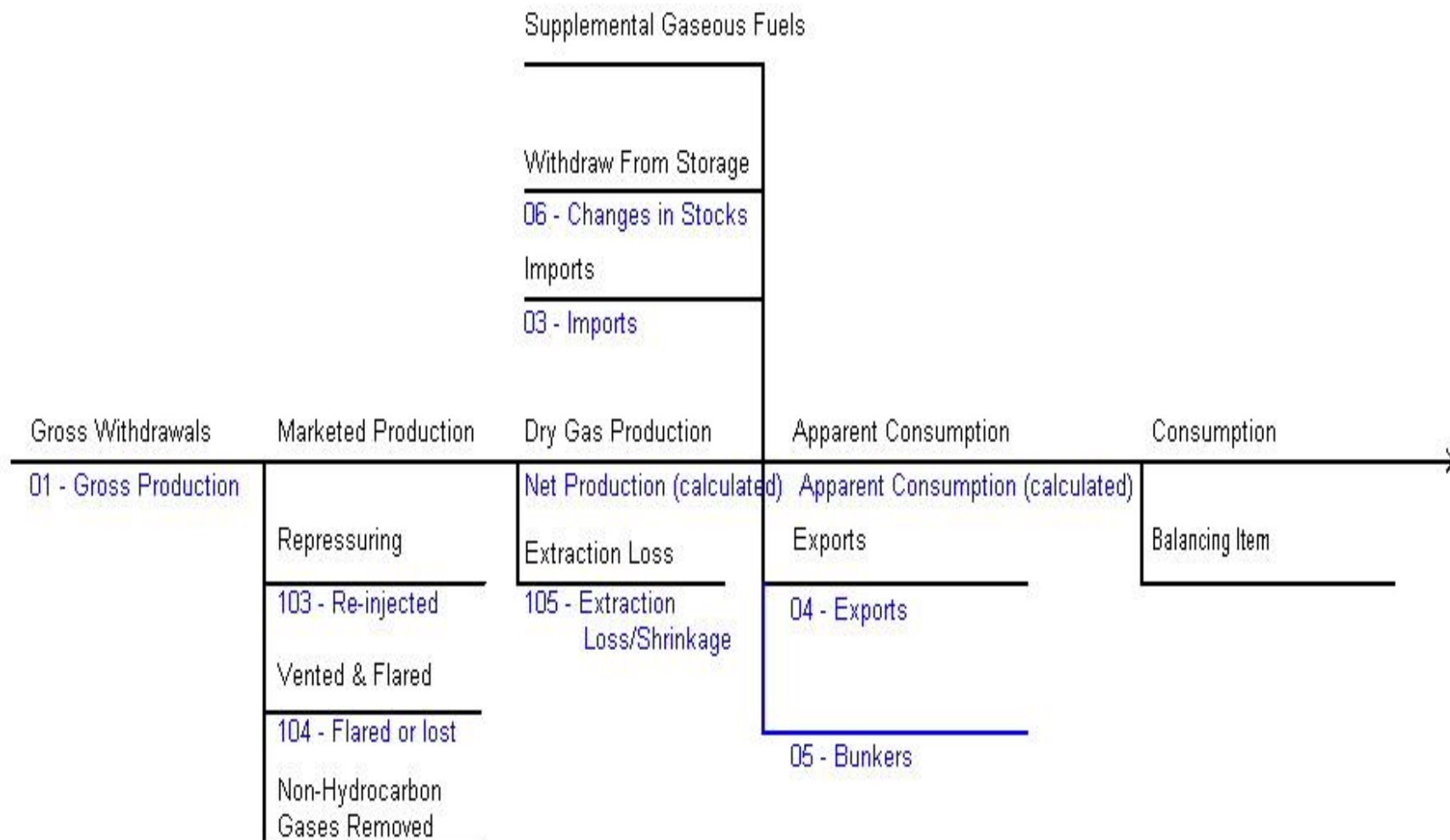
Gridded
Estimates

Isotopic
Carbon
Estimates

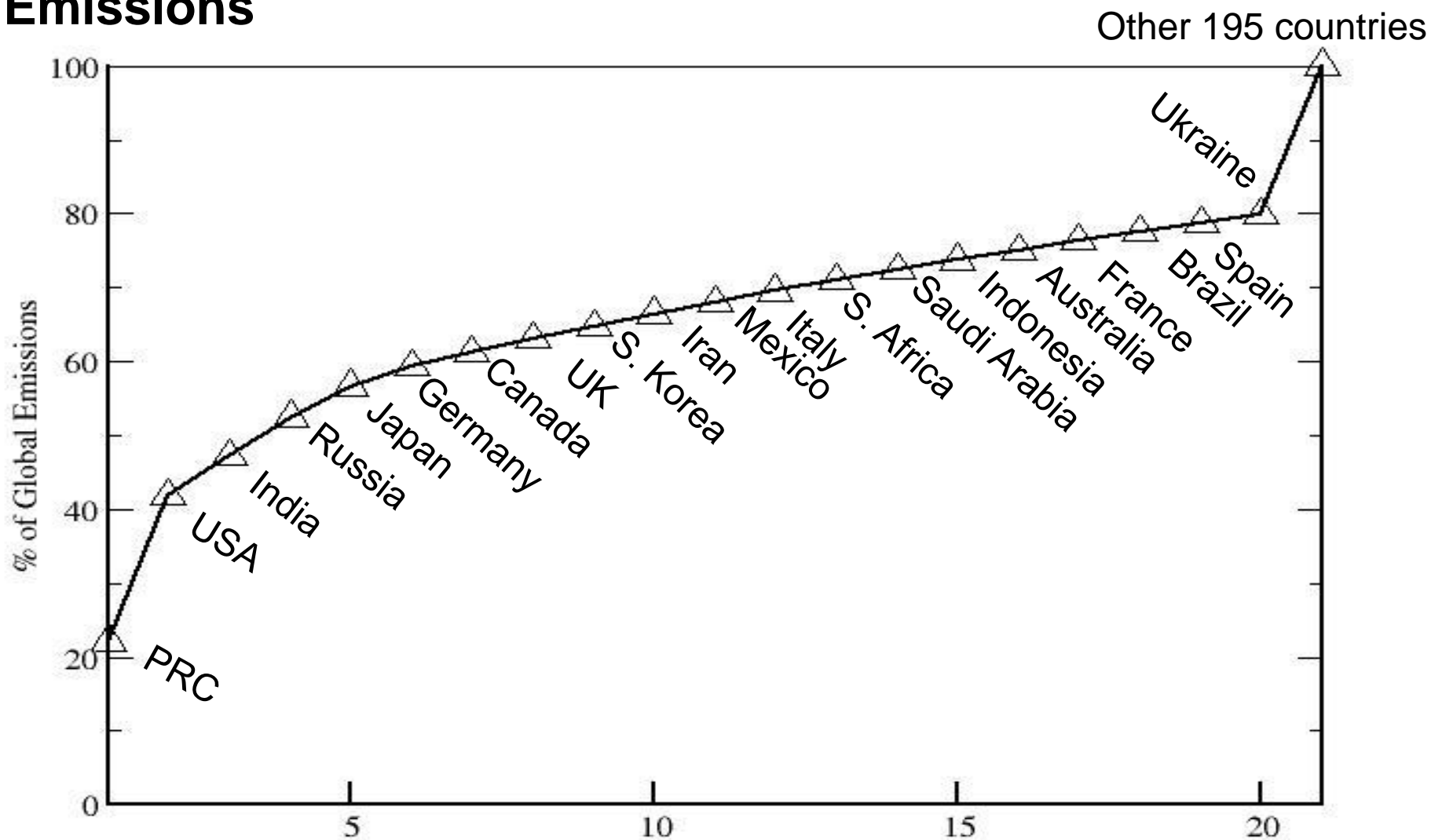
Kyoto
Evaluations



U.N. Vocabulary



Top 20 Emitting Nations in 2007 Account for 80% of Total Emissions



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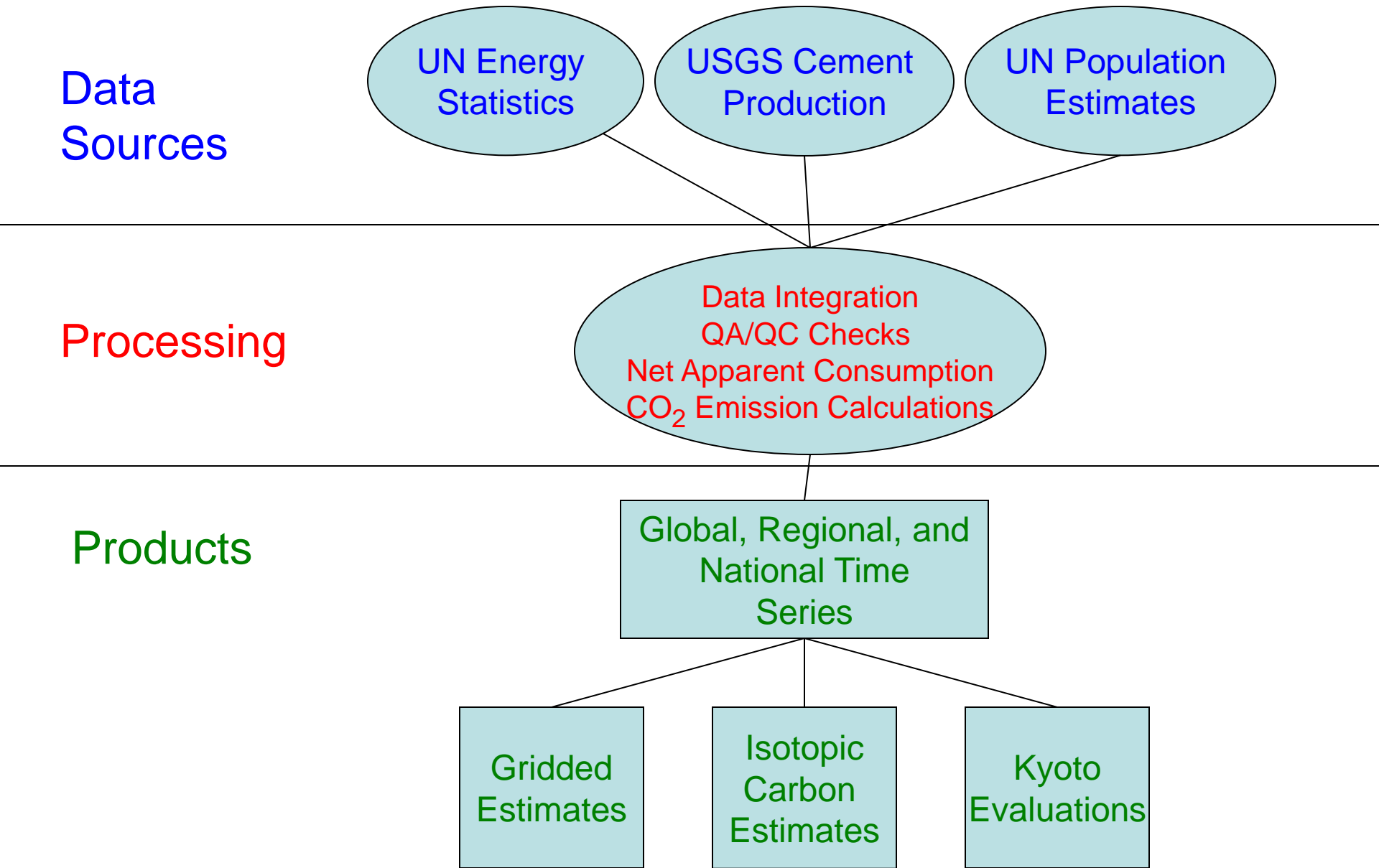
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Summary of Checks Performed Annually

- 1. Compare/overlay to previous UNSTAT version**
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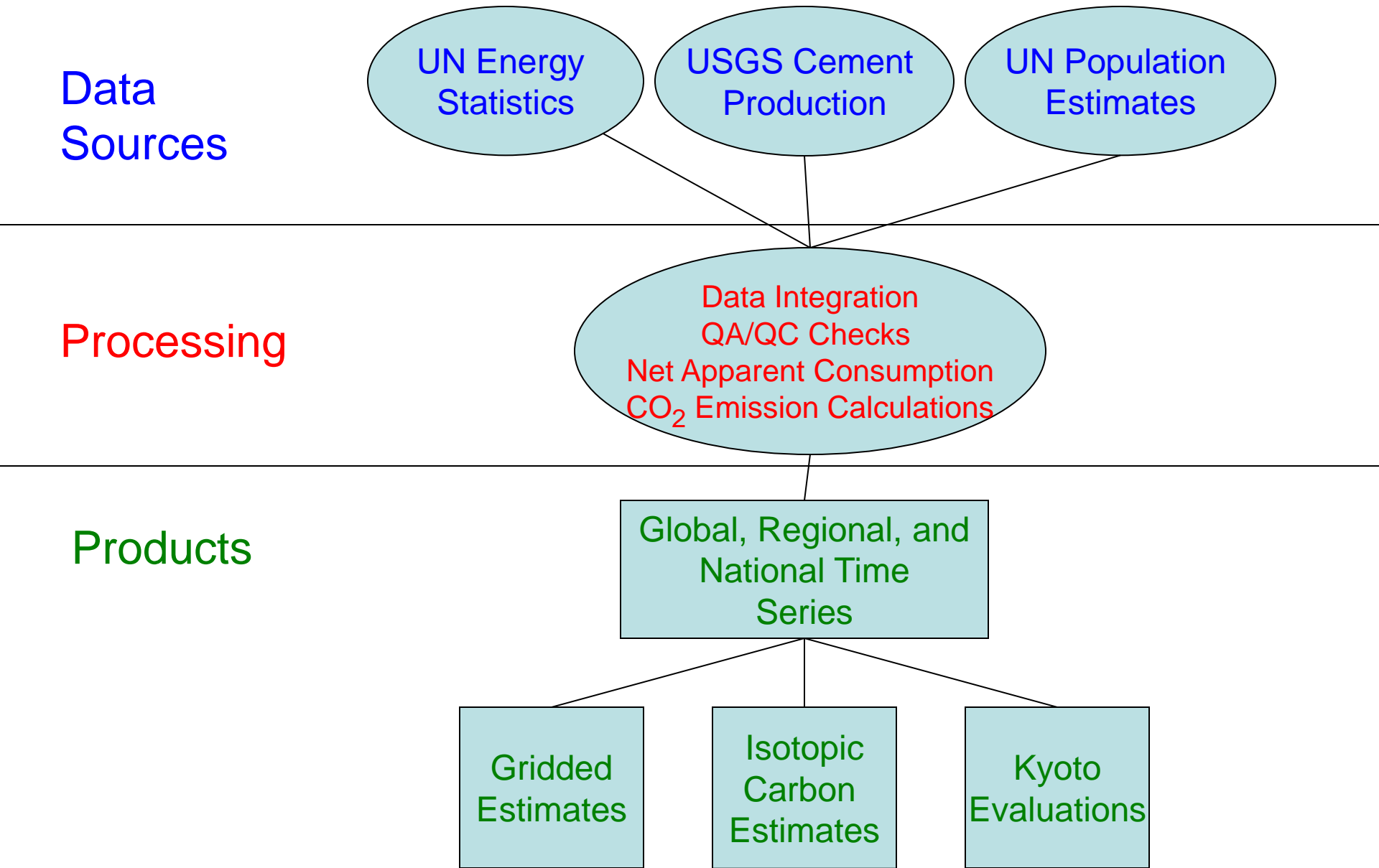
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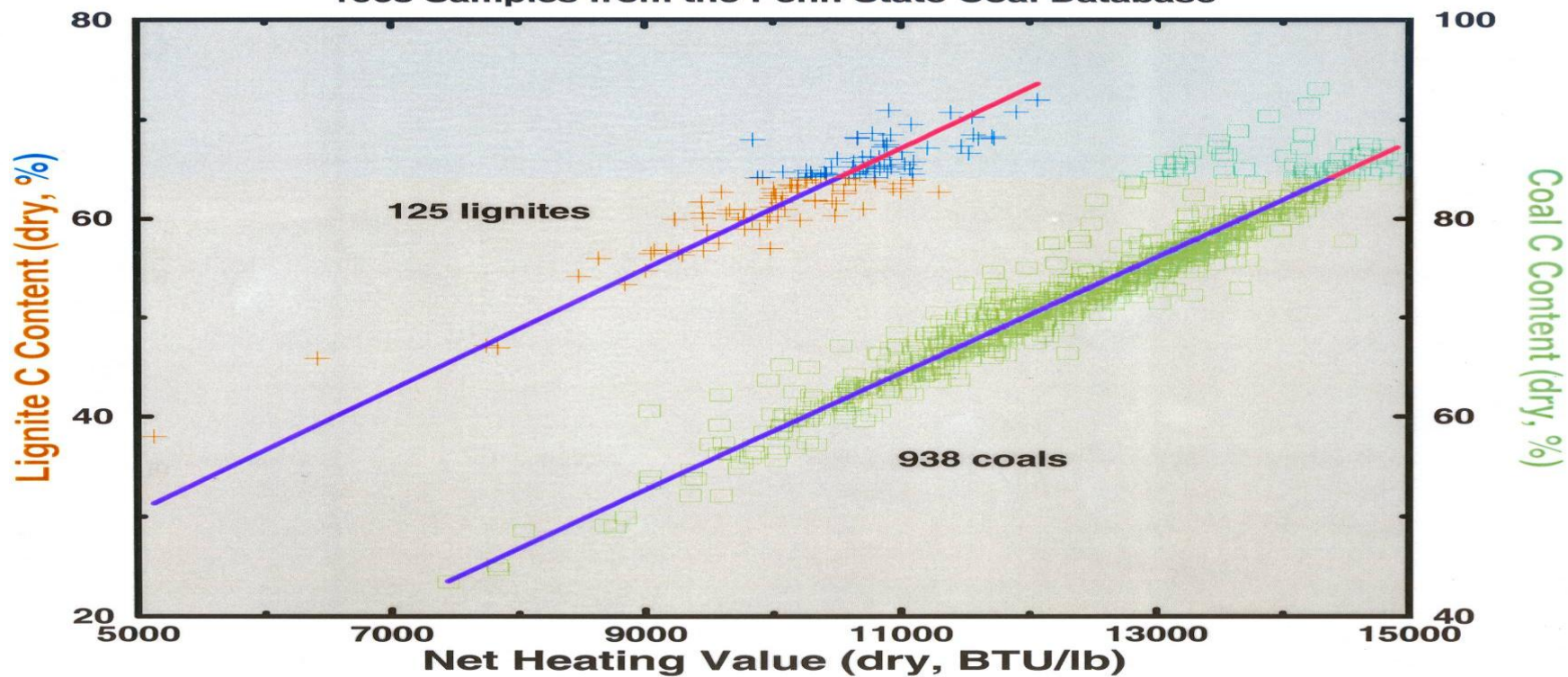
Isotopic
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Carbon Content versus Heating Value

1063 Samples from the Penn State Coal Database



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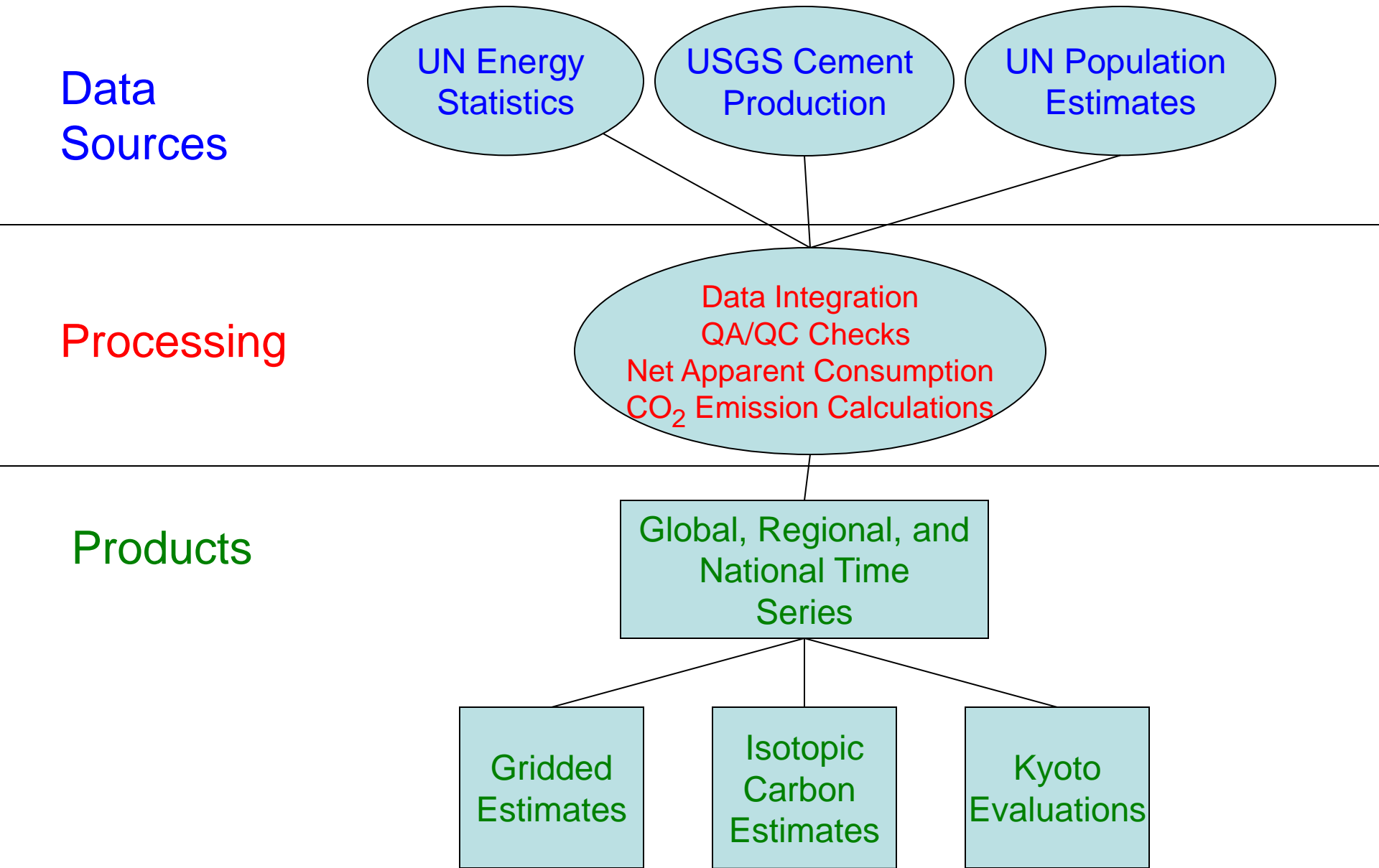
Products

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Estimates

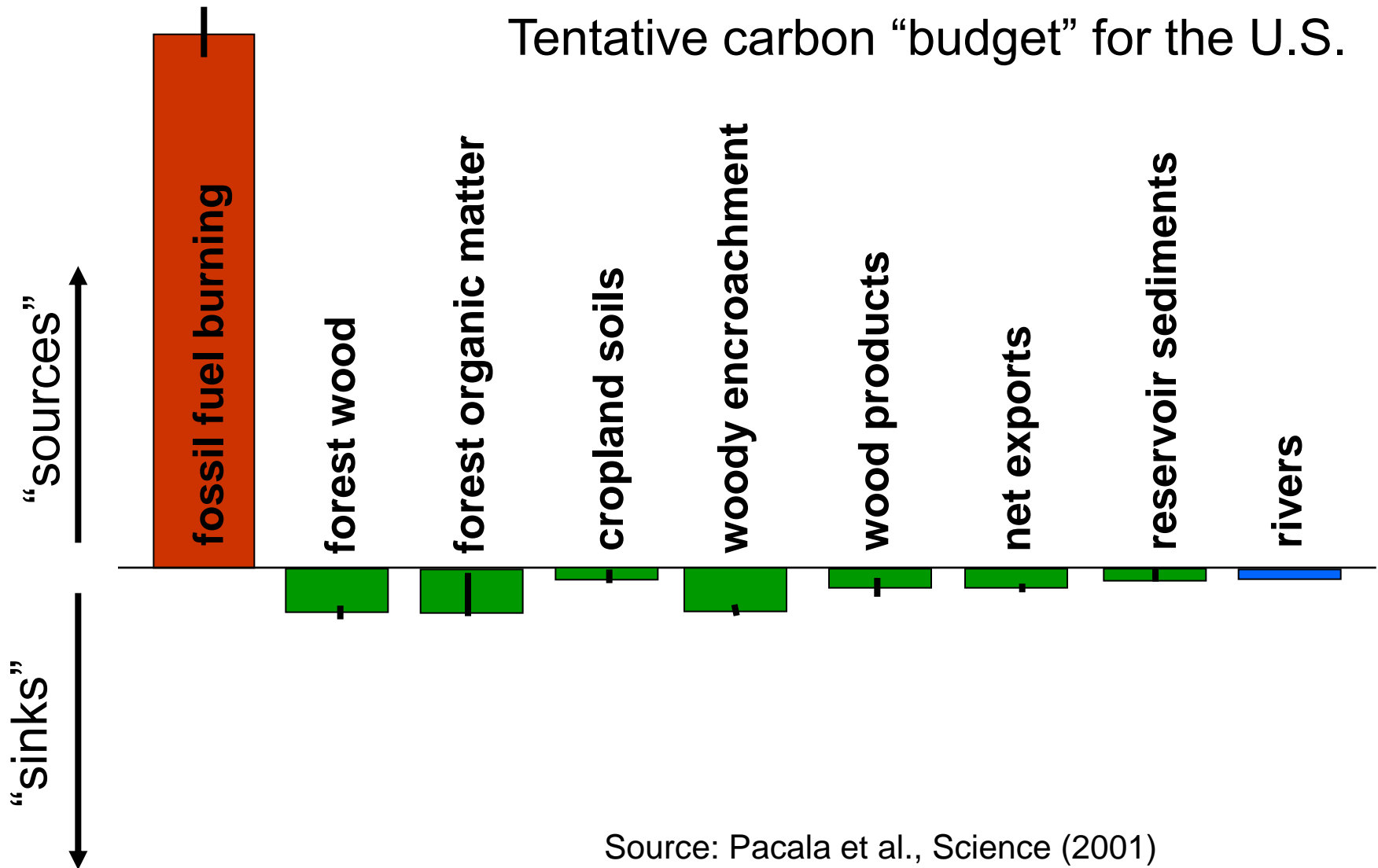
Isotopic
Carbon
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Kyoto
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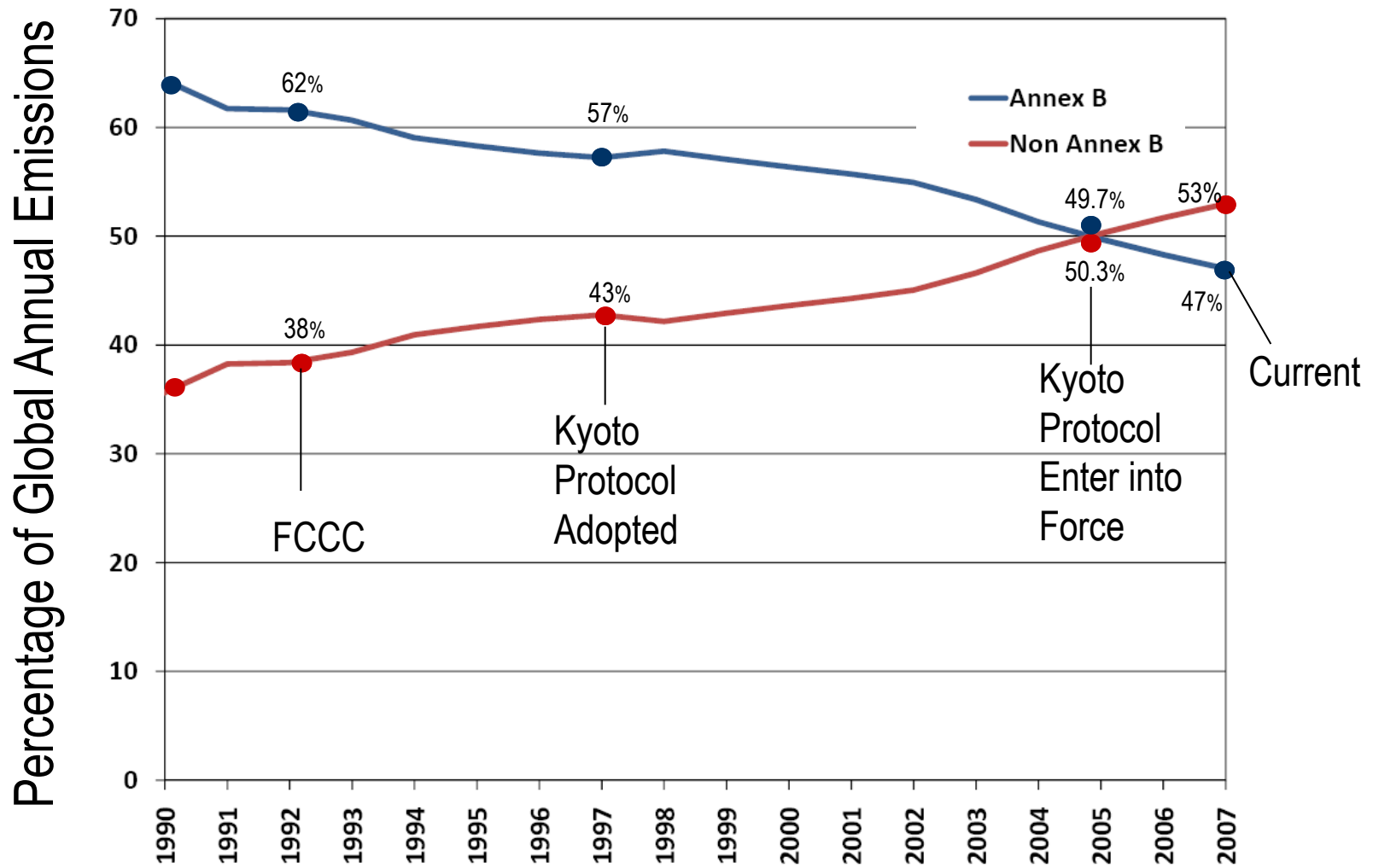
Emphasis on Emissions

Tentative carbon “budget” for the U.S.



Source: Pacala et al., Science (2001)

Regional Shift in Emissions Share



Data Sources

UN Energy
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USGS Cement
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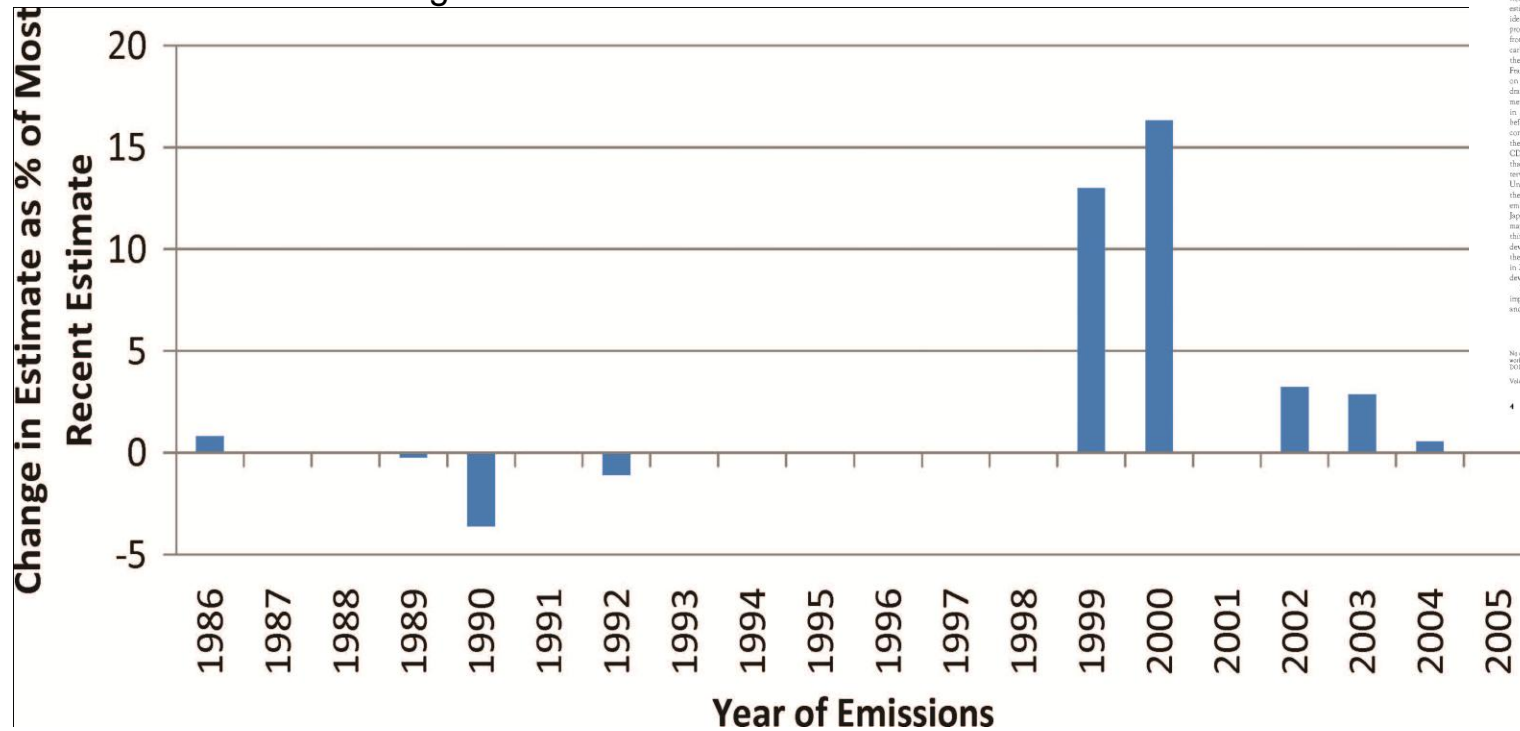
Isotopic
Carbon
Estimates

Kyoto
Evaluations

Finer
Resolution &
Independent
Estimates

Fossil-Fuel CO₂ Emission Uncertainties

Comparing the latest PRC estimates to the initial estimates for a given year. Positive values mean the most recent estimates are larger than the initial estimates.



CARBON ACCOUNTING AND DECARBONIZATION

How Uncertain Are Estimates of CO₂ Emissions?

Greg Marland, Khrysos Handal, and Mathias Jona

In September 2008, members at G8+8 (G8 plus the United States, India, Brazil, and Mexico) agreed to estimate that global emissions of carbon dioxide (CO₂) from fossil fuel burning and cement production had increased.

Can satellite or other remotely sensed data provide independent estimates—or even confirmation of existing estimates—for emissions from power plants, highways, projects, cities, countries, or groups of countries? The answer for now is no; estimates of emissions from fossil fuels are actually one of the best constrained pieces of data in analyzing the global carbon cycle.

But how certain are these numbers and similar estimates by the individual countries or by other international organizations? Of the many sources of greenhouse gas emissions, estimates of CO₂ from fossil fuel burning are the largest and most important in terms of impact on the climate, and they have the lowest quantitative uncertainty. How certain, then, are our best numbers of greenhouse gas emissions? Are they sufficiently certain for us to understand the global cycling of carbon before the net risk of carbon from the biosphere is often estimated as the residual of larger, more recently estimated terms, to enforce international agreements to limit emissions to the atmosphere (where national commitments for emissions reductions are generally smaller than the uncertainty in their emissions estimates), or to support national or international markets for trading in emissions permits (where, e.g., different greenhouse gas or greenhouse gas sources can have very different levels of uncertainty)? Currently, neither international agreements nor emissions trading programs consider the uncertainty in emissions estimates.

Writing in this special issue, one of us (Marland 2008) discussed some of the challenges of emissions accounting and the uncertainty that results. Estimates of uncertainty have traditionally been expert judgments based on the data input to the calculations. But for CO₂ emissions from fossil fuels, there are actually at least four approaches that one can take to gain some insight into the

No claim to original US government work
DOI: 10.1111/j.1550-0906.2009.01010.x
Volume 11, Number 1

Journal of Industrial Ecology
www.blackwellpublishing.com/jie

Marland et al. JIEC 2009

Approaches:

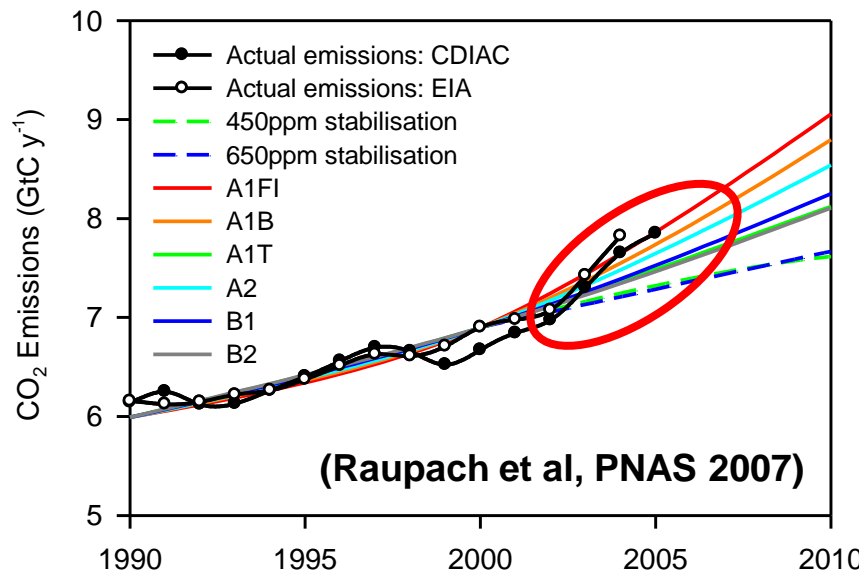
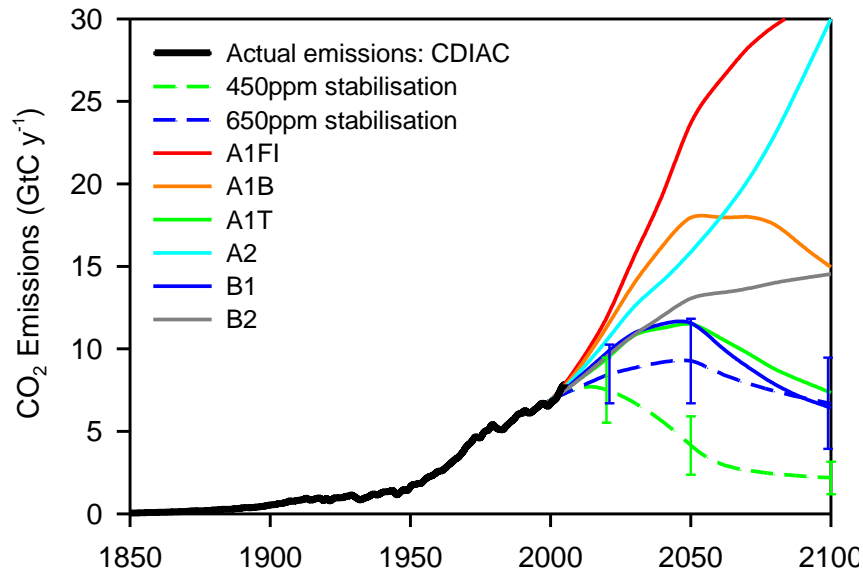
- 1) Comparison by independent methods,
- 2) Comparison from multiple sources,
- 3) Evolution over time from a single source, and
- 4) Modeled against remotely-sensed data

CDIAC Fossil-Fuel CO₂ Projections

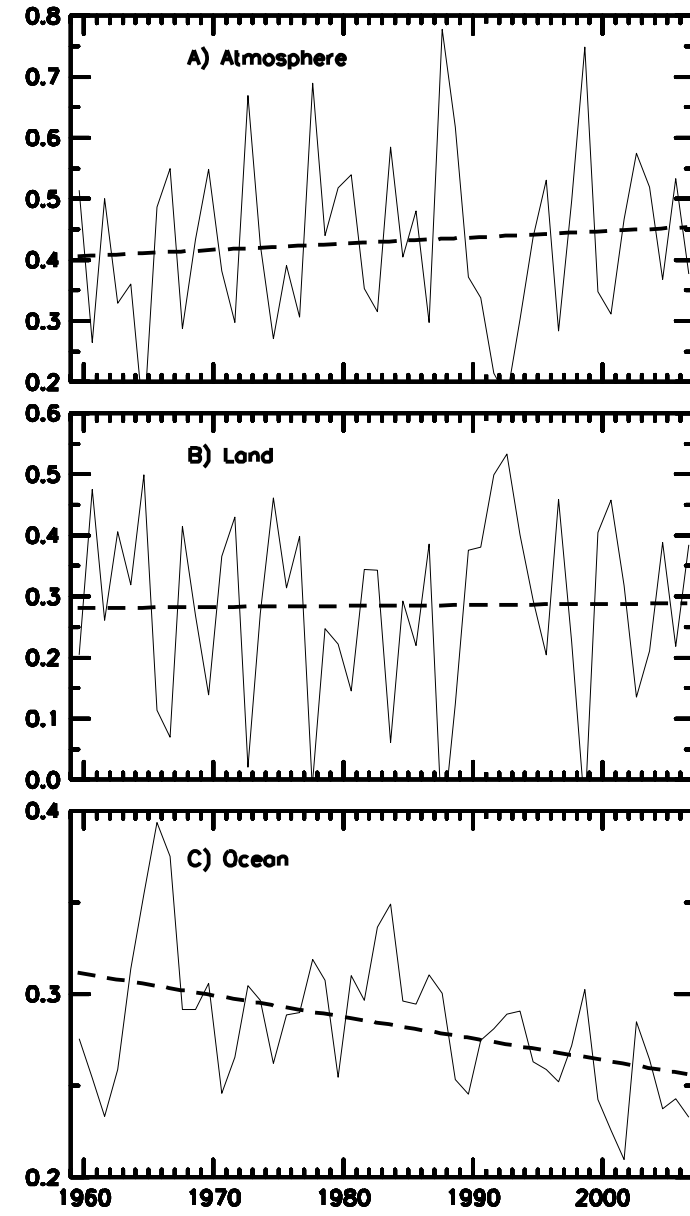
	Latest	Projection	Projection
	2007	2008	2009
USA	1.592	1.546	1.439
PRC	1.783	1.897	2.049
Global Total	8.365	8.511	8.399

Projections based on preliminary energy data published by British Petroleum for select countries and extrapolations of CDIAC national estimates through 2007.

CO₂ emissions are higher than anticipated and more is remaining in the atmosphere

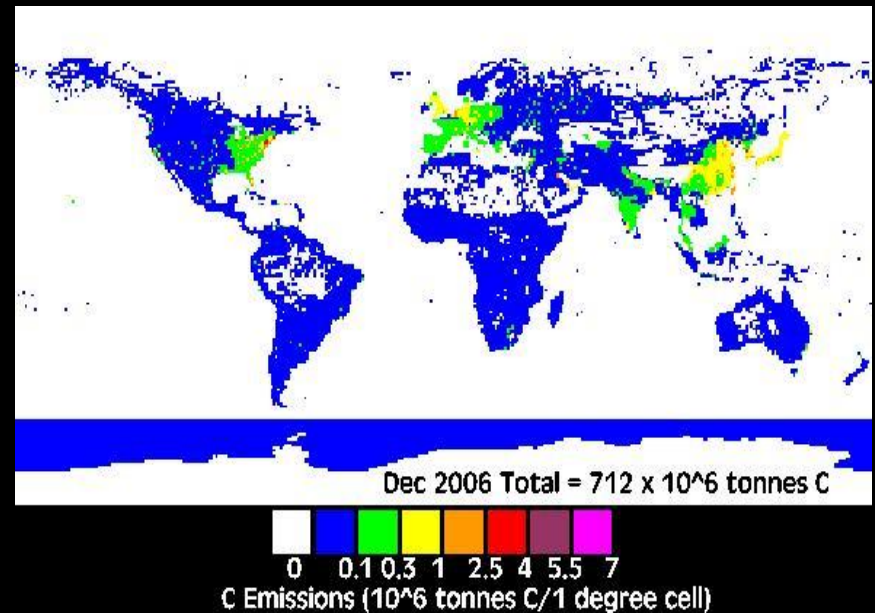
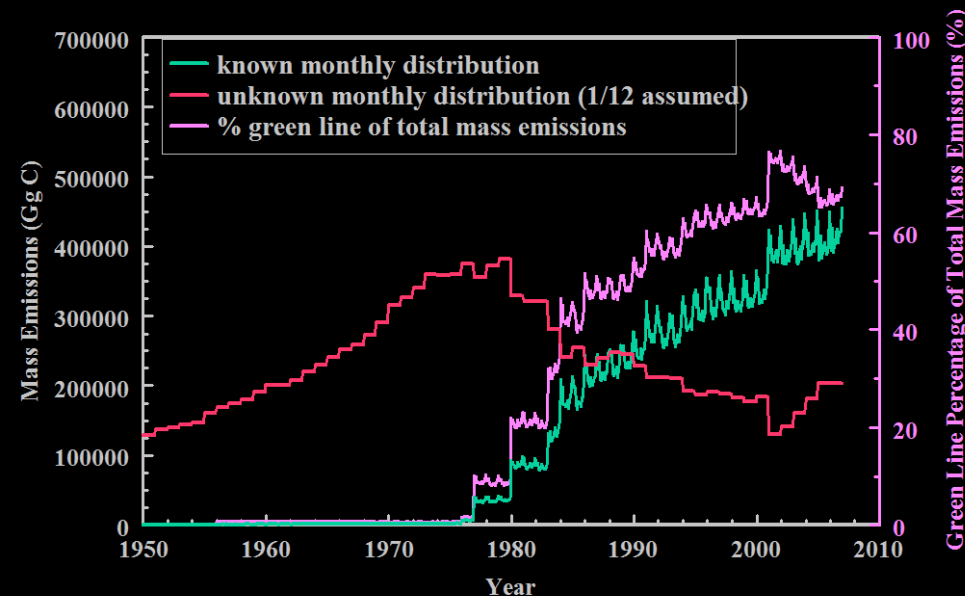
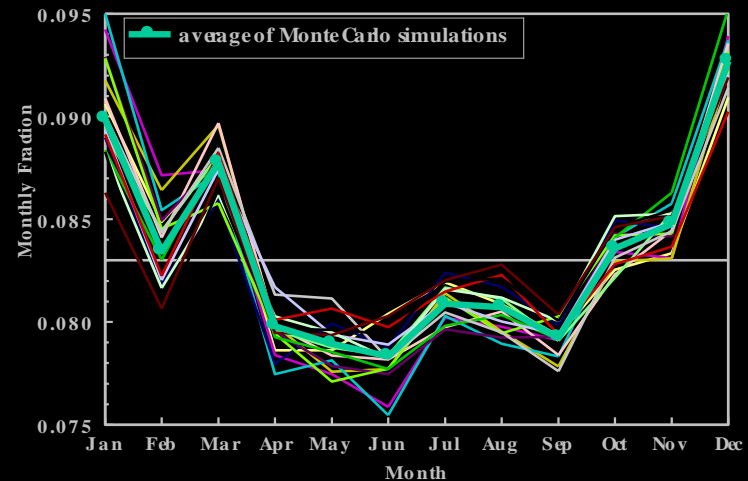


Fraction of fossil fuel emissions that remains in the atmosphere, the biosphere, and the ocean. (Canadell et al, PNAS 2007)



IPCC AR5 model runs

CDIAC provided monthly and annual, long-term (1751-2006), gridded (1 x 1) fossil-fuel CO₂ emission estimates to the AR5 modeling teams worldwide



<http://cdiac.ornl.gov/>

http://cdiac.ornl.gov/trends/emis/meth_reg.html

Fossil-Fuel CO2 Emission data publishing concept

CDIAC Web-site

Fossil-Fuel CO2 Emission

- Latest Published Global estimates
1751-2007.ems
- Preliminary 2007-08 Global & national estimates
Preliminary_CO2_Emission_2007_2008.xls
- Top 20 Emitting Nations Based on Latest (2007) Estimates
- Historical Global Estimates
- Gridded Annual Estimates
etc.

Visualization page



PHP and JavaScript code

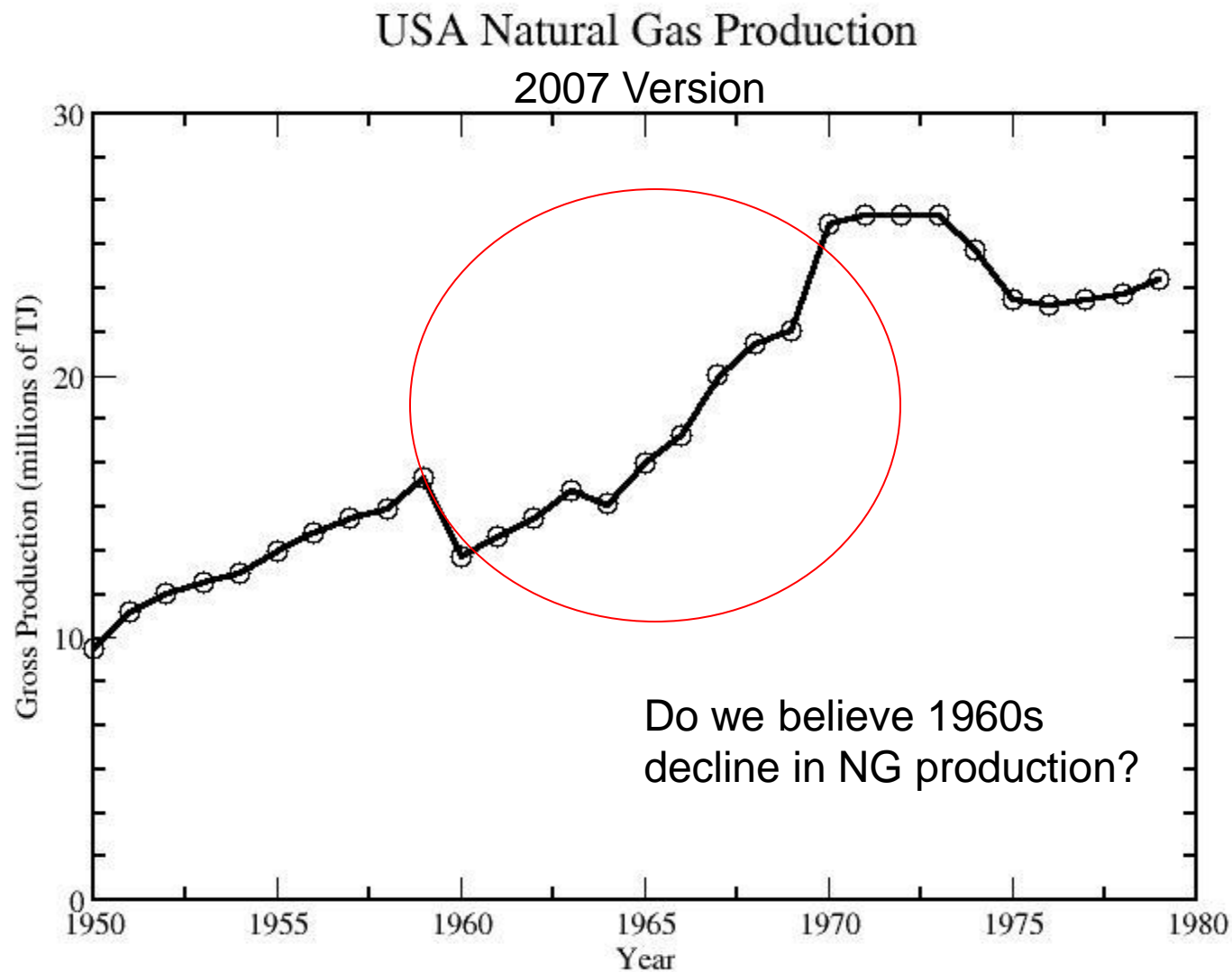
I.

1. Reads published files
2. Creates KML/KMZ data
3. Makes data visible on the web
(browser with Google Earth plug-in)
4. Creates downloadable file for Google Earth application

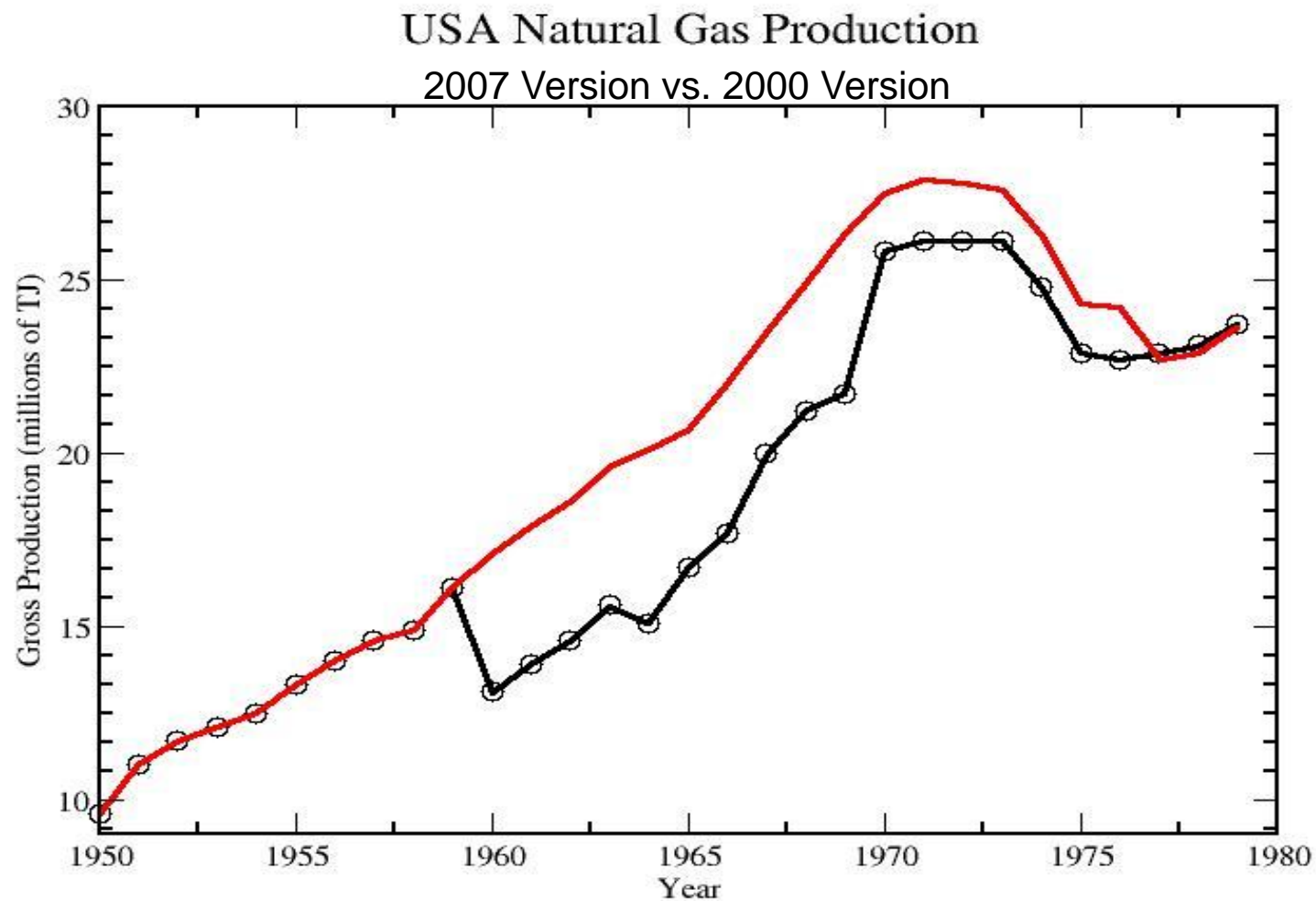
II.

1. Consolidate all data into one SQL DB
2. Provide PHP interface to create customized datasets based on users request

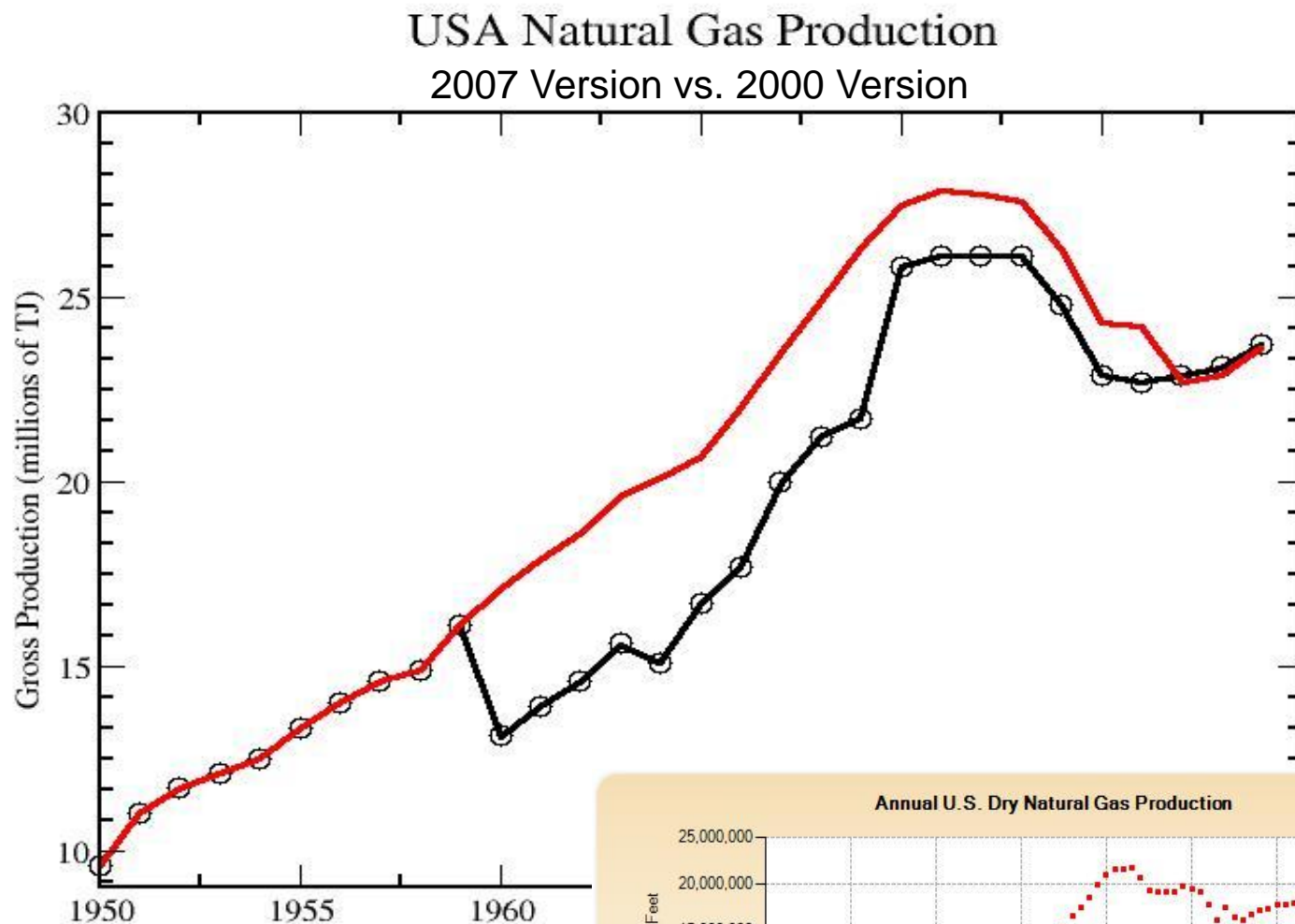
CDIAC Checks – Compare New Version to Last Version



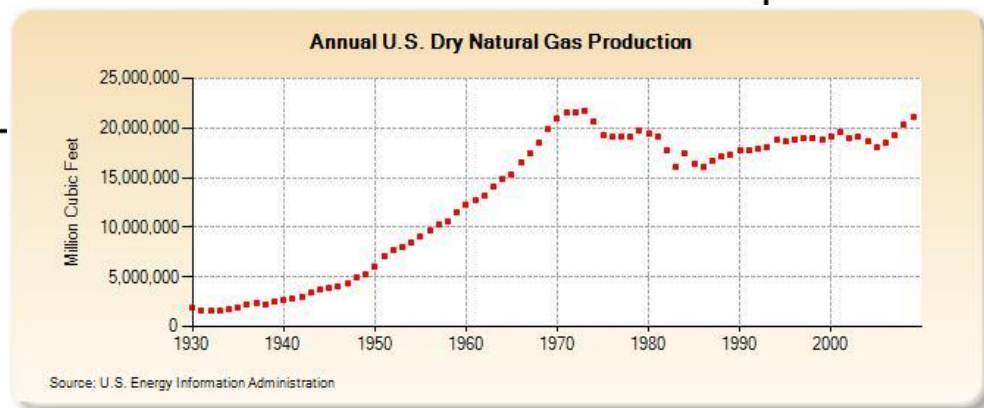
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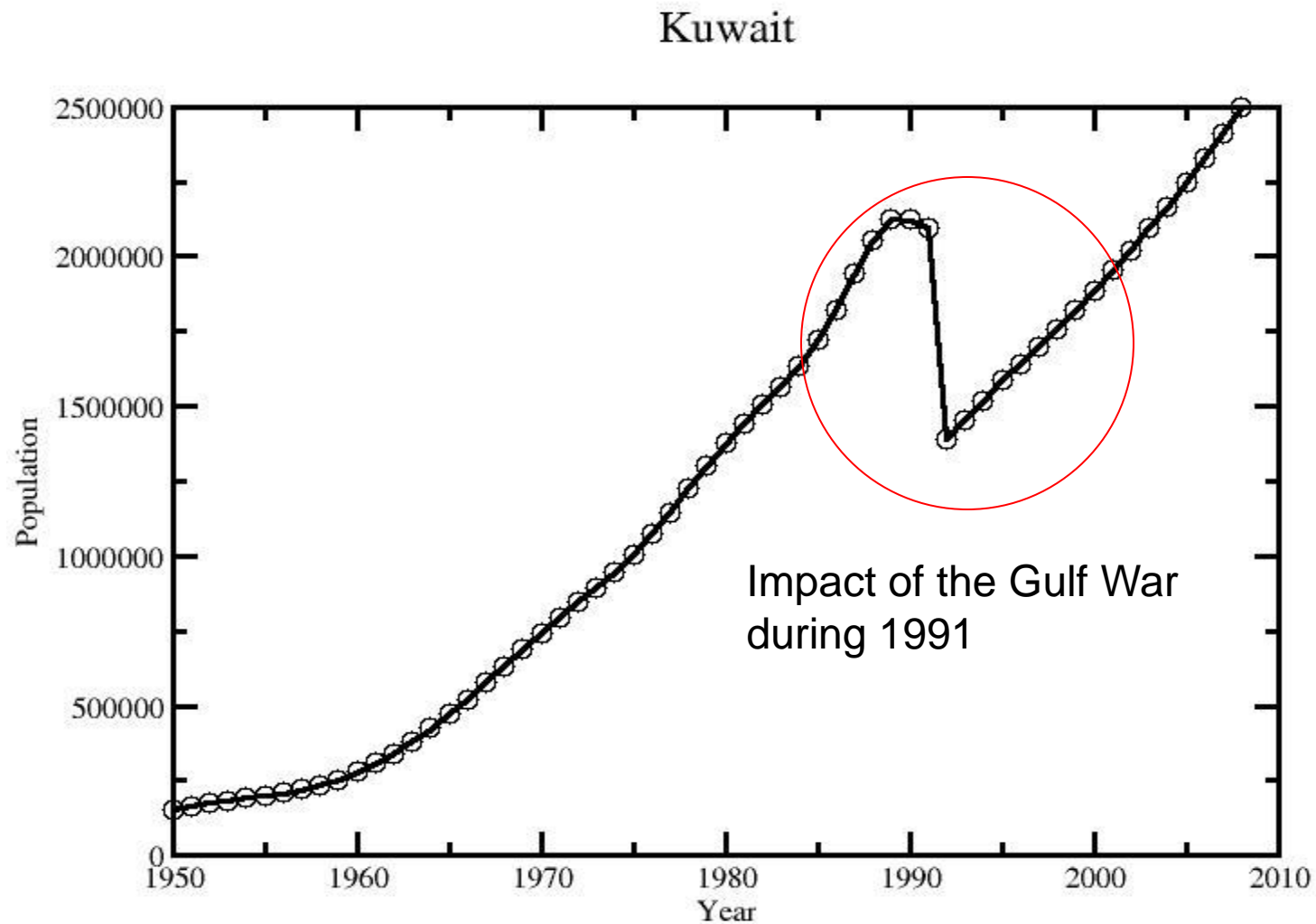
The “trend” in the published DOE EIA related NG data for the USA is consistent with the 2000 version of UNSTAT.



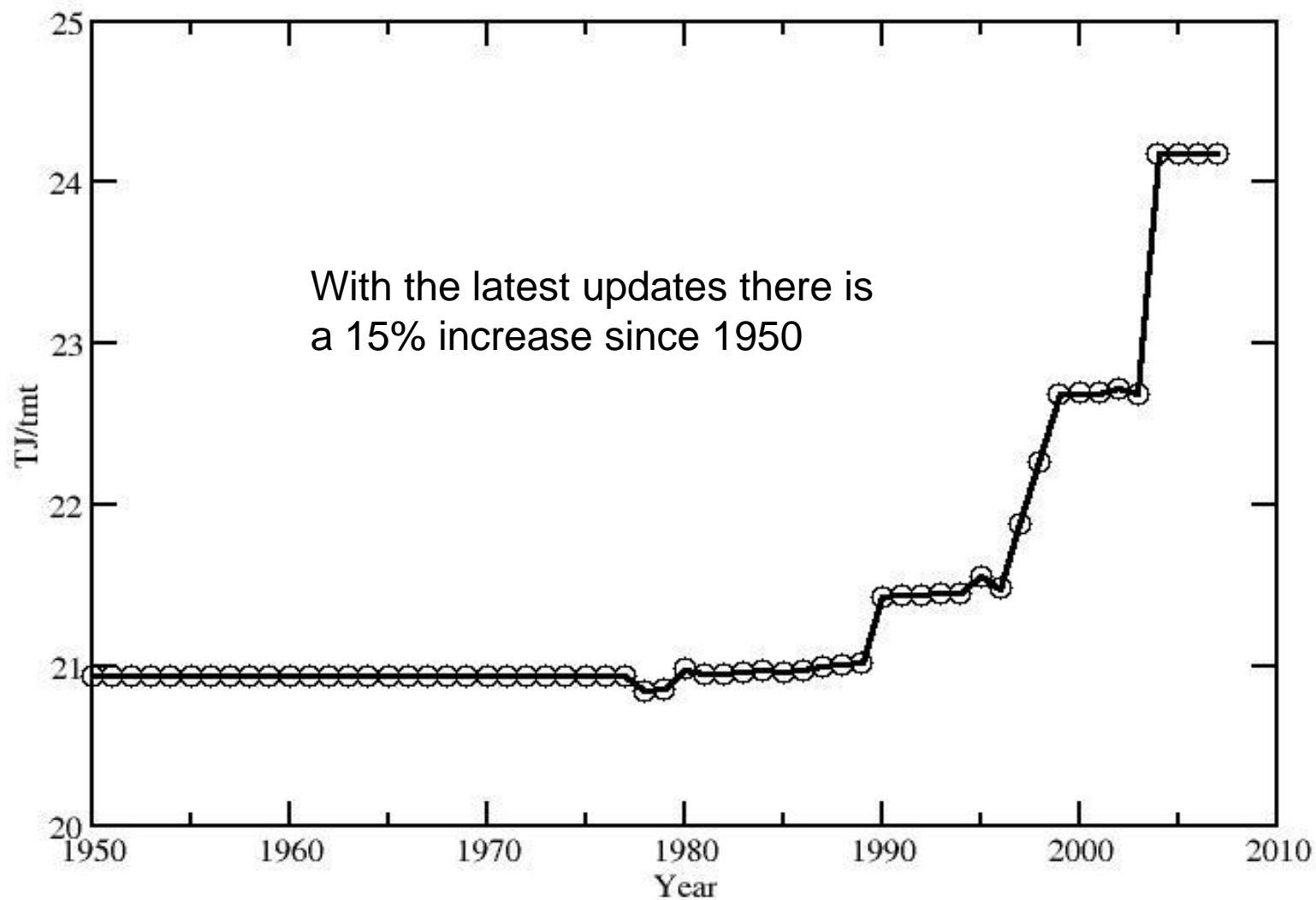
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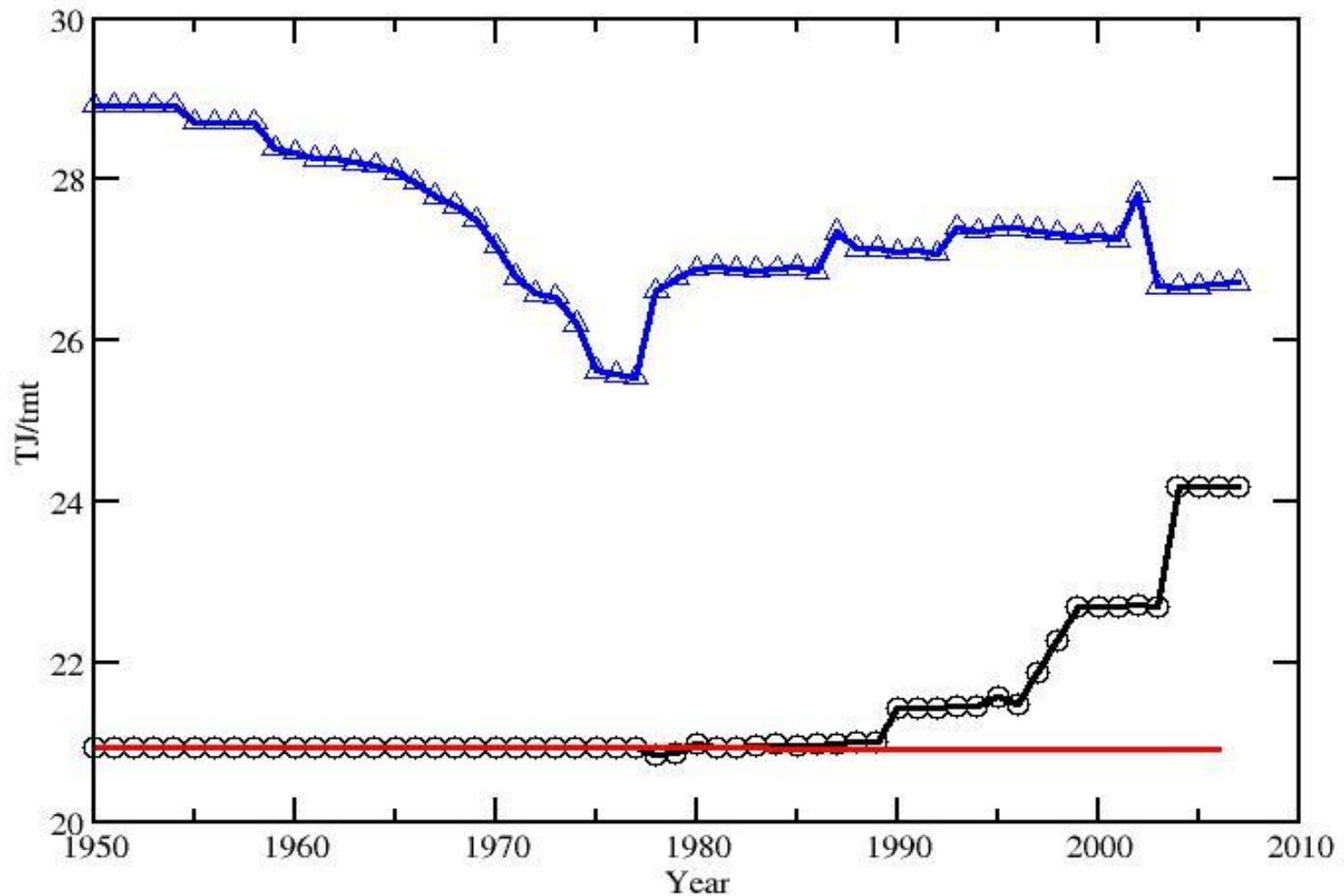
Understanding striking features in the population time series and their impact on per capita emission estimates



PRC Domestic Coal Conversion Factors



PRC & USA Domestic Coal Conversion Factors



Can we explain the increases in the PRC conversion factors (e.g., tapping higher quality coal reserves)?